WHAT IS CLAIMED IS:

1. An optical displacement sensor comprising:

a surface emitting laser light source for emitting a light beam having a predetermined shape;

a scale displaceable in such a manner as to cross said light beam emitted from said surface emitting laser light source and having a diffraction grating of a predetermined period for forming a diffraction interference pattern from said light beam; and

a photosensor for receiving a predetermined portion of said diffraction interference pattern, said photosensor including light intensity detecting means comprised of a plurality of light receiving areas arranged apart from one another in a pitch direction of said diffraction interference pattern on a light receiving surface at intervals of np1(z1+z2)/z1 where

z1 is a distance between a light-beam emitting surface of said surface emitting laser light source and a surface on which said diffraction grating is formed;

z2 is a distance between said surface on which said diffraction grating is formed and said light receiving surface of said photosensor;

p1 is a pitch of said diffraction grating on said scale; and

n is a natural number.

2. The optical displacement sensor according to claim 1, wherein said photosensor has second light

intensity detecting means having an output terminal independent from that of said light intensity detecting means, and

said second light intensity detecting means has a light receiving width of $mp1(z1+z2)/z1$ in said pitch direction of said diffraction interference pattern on said light receiving surface where m is a second natural number which can be set independently of said natural number n.

3. An optical displacement sensor comprising:

a light source for emitting coherent light;

a scale displaceable in such a manner as to cross a light beam as said coherent light emitted from said light source and having a diffraction grating of a predetermined period for forming a diffraction interference pattern from said light beam; and

axis-direction

a photosensor for receiving a predetermined portion of said diffraction interference pattern,

whereby a principal axis of said light beam as said coherent light emitted from said light source is tilted in a predetermined direction to a line perpendicular to that surface of said scale on which said light beam is irradiated.

4. An optical displacement sensor capable of detecting displacement of a scale, comprising:

a scale freely movable in a predetermined direction and having a diffraction grating of a

predetermined period provided in the same direction as the predetermined direction;

a surface emitting laser light source for irradiating a light beam approximately perpendicularly to the diffraction grating of the scale; and

a photosensor for detecting the light beam from the surface emitting laser light source which has passed through the diffraction grating of the scale, the photosensor having a plurality of light intensity detecting means aligned on a light detecting surface in the same direction as the pitch direction of the diffraction grating.

5. An optical displacement sensor according to claim 4, wherein the arrangement of the plurality of light intensity detecting means satisfies the following condition:

$$p2 = np1(z1+z2)/z1$$

where n is a voluntary natural number, p1 is the pitch interval of the diffraction grating, z1 is the distance between the light emitting surface of the surface emitting laser light source and the diffraction grating of the scale, and z2 is the distance between the diffraction grating of the scale and the light detecting surface of the photosensor.

6. An optical displacement sensor comprising:

a surface emitting laser light source for emitting a light beam having a predetermined shape;

a scale displaceable in such a manner as to cross the light beam emitted from the surface emitting laser light source and having a diffraction grating of a predetermined period formed thereon for forming a diffraction interference pattern from the light beam; and

a photosensor for receiving a predetermined portion of the diffraction interference pattern, characterized in that the light beam from the surface emitting laser light source has a beam size of 3 μm or larger on the light emitting surface with respect to the pitch direction of the diffraction grating.

7. An optical displacement sensor capable of detecting displacement of a scale, comprising:

a scale freely movable in a predetermined direction and having a diffraction grating of a predetermined period provided in the same direction as the predetermined direction;

a surface emitting laser light source for irradiating a light beam approximately perpendicularly to the diffraction grating of the scale; and

a photosensor for detecting the light beam from the surface emitting laser light source which has passed through the diffraction grating of the scale, characterized in that the light beam from the surface emitting laser light source has a beam size of 3 μm or larger on the light emitting surface in the same

direction as the pitch direction of the diffraction grating of the scale.

8. An optical displacement sensor according to claim 4, wherein the photosensor further includes second light intensity detecting means on the light detecting surface, and

the output of this second light intensity detecting means can be processed independently of the outputs of the plurality of light intensity detecting means.

9. An optical displacement sensor according to claim 8, wherein one or a plurality of second light intensity detecting means are provided, and a length in the same direction as the pitch direction of the diffraction grating of the scale is approximately equal to $mp1(z1+z2)/z1$, where m is any natural number, p1 is the pitch interval of the diffraction grating, z1 is the distance between the light emitting surface of the surface emitting laser light source and the diffraction grating of the scale, and z2 is the distance between the diffraction grating of the scale and the light detecting surface of the photosensor.

10. An optical displacement sensor according to claim 4, wherein the light intensity detecting means are aligned in plural columns.

11. An optical displacement sensor according to claim 10, wherein the individual columns of the light

intensity detecting means in the photosensor have the same pitch, and are shifted from one another by a predetermined amount.

12. An optical displacement sensor according to claim 11, wherein the amount of the positional deviation is an odd multiple of 1/4 of the pitch of the columns.

13. An optical displacement sensor according to claim 4, wherein the light intensity detecting means in the photosensor are separated into a plurality of groups which can provide outputs independently, and those light intensity detecting means in each group are alternately laid out.

14. An optical displacement sensor according to claim 13, wherein those light intensity detecting means in each group which are alternately laid out have the same pitch and the position deviation between those light intensity detecting means which belong to different groups is an odd multiple of 1/4 of the aforementioned pitch.

15. An optical displacement sensor comprising:

a surface emitting laser light source for emitting a light beam having a predetermined shape;

a scale displaceable in such a manner as to cross the light beam emitted from the surface emitting laser light source and having a diffraction grating of a predetermined period for forming a diffraction

interference pattern from the light beam; and

a photosensor for receiving a predetermined portion of the diffraction interference pattern, characterized in that

the surface emitting laser light source irradiates a plurality of light beams on the scale, and

the photosensor is comprised of a plurality of light intensity detecting means for selectively receiving individual diffraction interference patterns generated by the plurality of light beams.

16. An optical displacement sensor capable of detecting displacement of a scale, comprising:

a scale freely movable in a predetermined direction and having a diffraction grating of a predetermined period provided in the same direction as the predetermined direction;

a surface emitting laser light source for irradiating a light beam approximately perpendicularly to the diffraction grating of the scale; and

a photosensor for detecting the light beam from the surface emitting laser light source which has passed through the diffraction grating of the scale, characterized in that the photosensor can detect displacement of each diffraction pattern formed on the light receiving surface as the plurality of light beams are irradiated on the diffraction grating.

17. An optical displacement sensor comprising:

a surface emitting laser light source for emitting a light beam having a predetermined shape;

a scale displaceable in such a manner as to cross the light beam emitted from the surface emitting laser light source and having a diffraction grating of a predetermined period formed thereon for forming a diffraction interference pattern from the light beam; and

a photosensor for receiving a predetermined portion of the diffraction interference pattern, characterized in that

the scale has a plurality of diffraction grating areas having predetermined spatial phases different from one another,

the surface emitting laser light source irradiates independent light beams on the plurality of diffraction grating areas of the scale, and

the photosensor is comprised of a plurality of light intensity detecting means for respectively and selectively receiving the diffraction interference patterns generated by the plurality of diffraction grating areas.

18. An optical displacement sensor capable of detecting displacement of a scale, comprising:

a scale freely movable in a predetermined direction and having a plurality of diffraction gratings provided at a predetermined period in the same

pitch direction as the predetermined direction;

a surface emitting laser light source for irradiating a light beam approximately perpendicularly to each diffraction grating of the scale; and

a photosensor for detecting the light beam from the surface emitting laser light source which has passed through the diffraction grating of the scale, characterized in that

the photosensor can detect displacement of each diffraction pattern formed on the light receiving surface as the plurality of light beams are irradiated on the respective diffraction gratings.

19. An optical displacement sensor capable of detecting displacement of a scale, comprising:

a scale freely movable in a predetermined direction and having a diffraction grating of a predetermined period provided in the same pitch direction as the predetermined direction;

a coherent light source for irradiating a light beam to the diffraction grating of the scale; and

a photosensor for selectively detecting a specific portion of the light beam from the coherent light source which has been diffracted by the diffraction grating of the scale, characterized in that

the principal axis of the light beam from the coherent light source is tilted in a predetermined direction to a line perpendicular to the surface of the

diffraction grating.

20. An optical displacement sensor according to claim 19, wherein the pitch direction of the diffraction grating formed on the scale and the principal axis of the light beam from the coherent light source which emits the coherent light are arranged perpendicular to each other, and

the surface where the diffraction grating of the scale is formed is set in parallel to the light receiving surface of the photosensor.

21. An optical displacement sensor according to claim 19, wherein the pitch direction of the diffraction grating is perpendicular to the principal axis of the light beam from the coherent light source and the surface of the diffraction grating is parallel to the light receiving surface of the photosensor.

22. An optical displacement sensor comprising:

a light source for emitting coherent light;

a scale displaceable in such a manner as to cross a light beam as the coherent light emitted from the light source and having a diffraction grating of a predetermined period for forming a diffraction interference pattern from the light beam; and

a photosensor for receiving a predetermined portion of the diffraction interference pattern,

whereby a principal axis of the light beam as the coherent light emitted from the light source is tilted

in a predetermined direction to a line perpendicular to that surface of the scale on which the light beam is irradiated.

23. An optical displacement sensor according to claim 22, wherein the pitch direction of the diffraction grating formed on the scale is arranged perpendicular to the principal axis of the light beam from the light source that emits coherent light, and

the plane where the diffraction grating of the scale is formed is arranged in parallel to the light receiving surface of the photosensor.

24. An optical displacement sensor comprising:

a light source for emitting coherent light;

a scale displaceable in such a manner as to cross a light beam as the coherent light emitted from the light source and having a diffraction grating of a predetermined period for forming a diffraction interference pattern from the light beam; and

a photosensor for receiving a predetermined portion of the diffraction interference pattern,

wherein the light source and the photosensor are arranged on the same side with respect to the scale, and

the plane where the diffraction grating of the scale is formed is arranged perpendicular to the principal axis of the light beam to be emitted from the light source that emits the coherent light.

25. An optical displacement sensor capable of detecting displacement of a scale, comprising:

a scale freely movable in a predetermined direction and having a diffraction grating of a predetermined period provided in the same pitch direction as the predetermined direction;

a surface emitting laser light source for irradiating a light beam approximately perpendicular to the diffraction grating of the scale; and

a photosensor for detecting the light beam from the surface emitting laser light source which has passed through the diffraction grating of the scale.

26. An optical displacement sensor comprising:

a surface emitting laser light source for emitting a light beam having a predetermined shape;

a scale displaceable in such a manner as to cross the light beam emitted from the surface emitting laser light source and having a diffraction grating of a predetermined period for forming a diffraction interference pattern from the light beam; and

a photosensor for receiving a predetermined portion of the diffraction interference pattern.

27. An optical encoder comprising:

a coherent light source;

a scale movably supported and formed with a first scale pattern and a second scale pattern for reflecting or diffracting and passing a light beam from said

coherent light source;

a beam-splitting optical element, provided between said coherent light source and said scale, for splitting said light beam emitted from said coherent light source into a plurality of beams;

first and second photosensors for detecting said light beams split by said beam-splitting optical element,

said first photosensor having a plurality of light receiving areas formed at intervals of approximately np11(z11+z21)/z11 in a spatial period direction of a diffraction interference pattern formed on a light receiving surface as a first light beam split by said beam-splitting optical element is optically affected said first scale pattern, where z11 is an optical distance along a principal axis of said first light beam from a beam emitting surface of said coherent light source to a surface where said first scale pattern is formed, z21 is an optical distance along said principal axis of said first light beam to said first photosensor from said surface where said first scale pattern is formed to said first photosensor, p11 is a spatial period of said first scale pattern and n is a natural number,

a second light beam among said plurality of light beams split by said beam-splitting optical element being optically affected said second scale pattern and

being then received by said second photosensor.

28. The optical encoder according to claim 27, further comprising:

a first optical beam-bending element provided between said scale and said first photosensor; and

a second optical beam-bending element provided between said scale and said second photosensor,

whereby said first and second light beams which have been optically affected said first scale pattern and said second scale pattern pass through said second and third beam-splitting optical elements to be received by said first and second photosensors, respectively.

29. An optical encoder comprising:

a coherent light source;

a scale movably supported and formed with a first scale pattern and a second scale pattern for reflecting or diffracting and passing a light beam from said coherent light source;

a beam-splitting optical element, provided between said coherent light source and said scale, for splitting said light beam emitted from said coherent light source into a plurality of beams;

first and second photosensors for detecting said light beams split by said beam-splitting optical element,

said first photosensor having a plurality of light

receiving areas formed at intervals of approximately np11(z11+z21)/z11 in a spatial period direction of a diffraction interference pattern formed on a light receiving surface as a first light beam split by said beam-splitting optical element is optically affected said first scale pattern, where z11 is an optical distance along a principal axis of said first light beam from a beam emitting surface of said coherent light source to a surface where said first scale pattern is formed, z21 is an optical distance along said principal axis of said first light beam to said first photosensor from said surface where said first scale pattern is formed to said first photosensor, p11 is a spatial period of said first scale pattern and n is a natural number,

a second light beam among said plurality of light beams split by said beam-splitting optical element being received by said second photosensor without being irradiated on any scale pattern.

30. An optical encoder according to claim 27, wherein the beam-splitting optical element is disposed in such a way as to include the principal axis of the light beam immediately after it has been emitted from the coherent light source and to split the principal axis of the light beam into a plurality of directions only in the plane perpendicular to the pitch direction of the first scale pattern.

31. An optical encoder according to claim 27, wherein the second scale pattern has a uniform reflectance, transmissivity or diffraction efficiency.

32. An optical encoder according to claim 27, wherein given that the second scale pattern has a predetermined period p1 different from that of the first scale pattern, the second photosensor has a plurality of light receiving areas formed at intervals of approximately np12(z12+z22)/z12 in the spatial period direction of the diffraction interference pattern, where z12 is an optical distance measured along the principal axis of the second light beam that extends from the beam emitting surface of the coherent light source to the surface where the second scale pattern is formed, and z22 is an optical distance measured along the principal axis of the second light beam and extending to the light receiving surface of the second photosensor from the surface where the second scale pattern is formed.

33. An optical encoder according to claim 27, wherein the second scale pattern is a single scale pattern or a plurality of scale patterns formed at a predetermined reference position.

34. An optical encoder according to claim 28, wherein the first, second and third beam-splitting optical element and the first and second optical beam-bending elements are disposed in such a way as

to include the principal axis of the light beam immediately after it has been emitted from the coherent light source and to split the principal axis of the light beam into a plurality of directions only in the plane perpendicular to the pitch direction of the first scale pattern.

35. An optical encoder according to claim 28, wherein the second scale pattern has a uniform reflectance, transmissivity or diffraction efficiency.

36. An optical encoder according to claim 28, wherein given that the second scale pattern has a predetermined period p1 different from that of the first scale pattern, the second photosensor receives the diffraction interference pattern produced by the second scale pattern through a beam-splitting optical element the same as or separate from the first beam-splitting optical element and has a plurality of light receiving areas formed at intervals of approximately np12(z12+z22)/z12 in the spatial period direction of the diffraction interference pattern, where z12 is an optical distance measured along the principal axis of the second light beam that extends from the beam emitting surface of the coherent light source to the surface where the second scale pattern is formed, and z22 is an optical distance measured along the principal axis of the second light beam and extending to the light receiving surface of the second photosensor from

the surface where the second scale pattern is formed.

37. An optical encoder according to claim 28, wherein the second scale pattern is a single scale pattern or a plurality of scale patterns formed at a predetermined reference position.

38. An optical encoder comprising:

a coherent light source capable of emitting a plurality of light beams;

a scale displaceable in such a way as to cross the light beams emitted from the coherent light source and formed with a first scale pattern of a predetermined period for generating a diffraction interference pattern from a first light beam emitted from the coherent light source; and

a first photosensor for receiving the diffraction interference pattern, the first photosensor having a plurality of light receiving areas formed at intervals of approximately $np11(z11+z21)/z11$ in the spatial period direction of the diffraction interference pattern so as to receive a predetermined portion of the diffraction interference pattern, where z11 is an optical distance measured along the principal axis of the first light beam that extends from the beam emitting surface of the coherent light source to the surface where the second scale pattern is formed, z21 is an optical distance measured along the principal axis of the first light beam and extending to the light

receiving surface of the first photosensor from the surface where the second scale pattern is formed, p11 is the spatial period of the first scale pattern and n is a natural number,

characterized in that the coherent light source and the first photosensor are arranged at approximately equal optical distances from the scale and on the same side and the principal axes of the light beams to be emitted from the coherent light source are arranged in such a way as to be tilted to the scale surface only within the plane including the principal axes of the light beams to be emitted from the coherent light source and perpendicular to the spatial period direction of the first scale pattern, the second light beam among the plurality of light beams is irradiated on the second scale pattern formed integral with the scale, and a second photosensor for receiving the second light beam that has been reflected or diffracted by or has passed through the second scale pattern is provided.